Extended abstract

Interactions between seabirds and fisheries in the French EEZs: implications for conservation and management

by

Cédric COTTÉ* (1, 2), Karine DELORD (1), Clara PÉRON (1), Charles-André BOST (1), Guy DUHAMEL (2), Patrice PRUVOST (2), Nicolas GASCO (2), Alexis MARTIN (2) & Henri WEIMERSKIRCH (1)

Incidental mortality of seabirds on fishing vessels is well documented and there is mounting evidence that longline fishing is a major cause of observed decrease of albatross and petrel populations (Brothers, 1991). Interactions with fishery activities often have lethal consequences and assessing the magnitude of these potential interactions is therefore a priority. The Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR), the Agreement on the Conservation of Albatross and Petrels (ACAP), the Southern Indian Ocean Fisheries Agreement (SIOFA), and BirdLife International thus recommend a better identification of overlapping areas between seabirds and fisheries, and an assessment of interactions likely to induce incidental mortality on as fine a spatio-temporal scale as possible. This can be achieved through the use of remote telemetry to identify seabird distributions, along with data on the distribution of commercial fishing effort (Weimerskirch, 1998) to quantify their spatio-temporal overlap (e.g., Cuthbert *et al*., 2005). Following the implementation of a subset of the mitigation measures suggested by CCAMLR in the French exclusive economic zones (EEZs) fisheries, mitigation efforts have reduced this mortality from 10 000 individuals in the late 1990s to 100s in the late 2000s (Delord *et al*., 2005, 2010). For over two decades, seabirds have been monitored at sea simultaneously during fishery activities in the Kerguelen EEZ. We used satellite tracking on four species of procellariforms (wandering albatross *Diomedea exulans*, black-browed albatross *Thalassarche melanophrys*, white-chinned petrel *Procellaria aequinoctialis* and grey petrel *Procellaria cinerea*) to investigate their spatial and temporal interactions with fisheries distributions. We distinguished three periods of fishery activity using location, time and type of gear used: trawling only (before 1992), trawling and longlining (between 1992 and 2002), and longlining only (after 2002-ongoing). We estimated overlap indices (Fieberg and Kochanny, 2005) for each species, according their origin and the fishery period. To quantify the association between seabirds and vessels on the highest resolution (i.e., the nominal location data), we also performed a dynamic interaction analysis (adapted from Kernohan *et al*., 2001). Fishing operations are mostly on the edge of the Kerguelen shelf. In the 1990's trawling grounds had a patchy distribution that has been extended to the whole shelf break in the early 2000's by the use of longline. Wandering albatrosses (breeding adults and immatures) from Kerguelen and Crozet forage across the Kerguelen EEZ, targeting mainly the shelf break. The overlap indices increased during the whole period for breeding wandering albatrosses, probably in response to the growing fishing effort. Black-browed albatross presents lower overlap with fishing operations. However, a shift of their distribution may be linked to the change of fishery activity and area. For both albatrosses, the increasing overlap is significantly related to the increase in fishing effort and surface prospected by longline vessels (GLM analyses). A low overlap is found for white-chinned and grey petrels. The dynamic analysis of seabird and vessel locations shows strong co-occurrence of both wandering (breeding and immature) and black-browed albatrosses. They spent a substantial amount of time associated with vessels (7-25% of location with vessels relative to total number of locations during the trip in the Kerguelen EEZ). This supports the hypothesis that foraging activity of albatrosses is highly linked to fishery activities. Moreover, an increase in the proportion of locations associated with vessels is exhibited for breeding wandering albatross (since 1994) and for black-browed albatross (since 2004). These results have strong implications in terms of seabirds conservation and ecosystem management. As a practical application, long-term inter-annual tracking of albatrosses will allow the identification of important marine bird areas as important viable zones for naturally occurring bird populations.

Acknowledgements. - We wish to thank all the fieldwork participants, especially A. Catard, Y. Charbonnier, A. Jacquet, J. Nezan, M. Nevoux, J.-B. Pons, J.-B. Thiebot, all field assistants - VCATs and CEs-, and fishing observers on board vessels. The work was supported by the Syndicat des Armements Réunionnais des Palangriers Congélateurs (SARPC), by the French Southern Territories (TAAF), by the French Polar Institute (IPEV: program n°109), by ANR 07 Biodiv Glides and by the "Prince Albert II de Monaco Foundation".

REFERENCES

BROTHERS N., 1991. - Albatross mortality and associated bait loss in the Japanese longline fishery in the Southern Ocean. *Biol. Conserv*., 55: 255-268.

Key words. - Seabirds - Procellariforms - Fisheries - Monitoring - Spatio-temporal overlap - Dynamic interactions.

(1) Centre d'Études Biologiques de Chizé, UPR 1934 CNRS, 79360 Villiers-en-Bois, France. [delord@cebc.cnrs.fr] [peron@cebc.cnrs.fr] [bost@cebc.cnrs.fr] [henriw@cebc.cnrs.fr]

(2) Département Milieux et Peuplements aquatiques, Muséum national d'Histoire naturelle, UMR 5178 USM 401, CP26, 43 rue Cuvier, 75231 Paris CEDEX 05, France. [cecotte@cebc.cnrs.fr] [duhamel@mnhn.fr] [pruvost@mnhn.fr] [nicopec@hotmail.fr] [alexis.martin@mnhn.fr]

* Corresponding author [cecotte@cebc.cnrs.fr]

DELORD K., GASCO N., WEIMERSKIRCH H. & MICOL T., 2005. - Seabird mortality in the Patagonian toothfish longline fishery around Crozet and Kerguelen islands, 2001-2003. *CCAMLR Sci*., 12: 53-80.

DELORD K., GASCO N., BARBRAUD C. & WEIMERSKIRCH H., 2010. - Multivariate effects on seabird bycatch in the legal Patagonian toothfish longline fishery around Crozet and Kerguelen Islands. *Polar Biol*., 33: 367-378.

CUTHBERT R., HILTON G., RYAN P.G. & TUCK G.N., 2005. - At-sea distribution of breeding Tristan albatrosses *Diomedea dabbena* and potential interactions with pelagic longline fishing in the South Atlantic Ocean. *Biol. Conserv*., 121: 345-355.

FIEBERG J. & KOCHANNY C.O., 2005. - Quantifying home-range overlap: the importance of the utilization distribution. *J. Wildl. Manage*., 69:1346-1359.

KERNOHAN B.J., GITZEN R.A. & MILLSPAUGH J.J., 2001. - Analysis of animal space use and movements. *In:* Radio Tracking and Animals Populations (Millspaugh J.J. & Marzluff J.M., eds), pp. 125-166. San Diego, California, USA: Academic Press.

WEIMERSKIRCH H., 1998. - Foraging strategies of southern albatrosses and their relationship with fisheries. *In:* Albatross Ecology and Conservation (Robertson G. & Gales R., eds), pp. 84-91. Chipping Norton: Surrey Beatty,